

Monitoring Kentucky's Climate: The Kentucky Mesonet at WKU

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Kentucky Water Resources Board
Frankfort, Kentucky
August 29, 2016

Kentucky's Weather and Climate Extremes

Warren County, May 2010

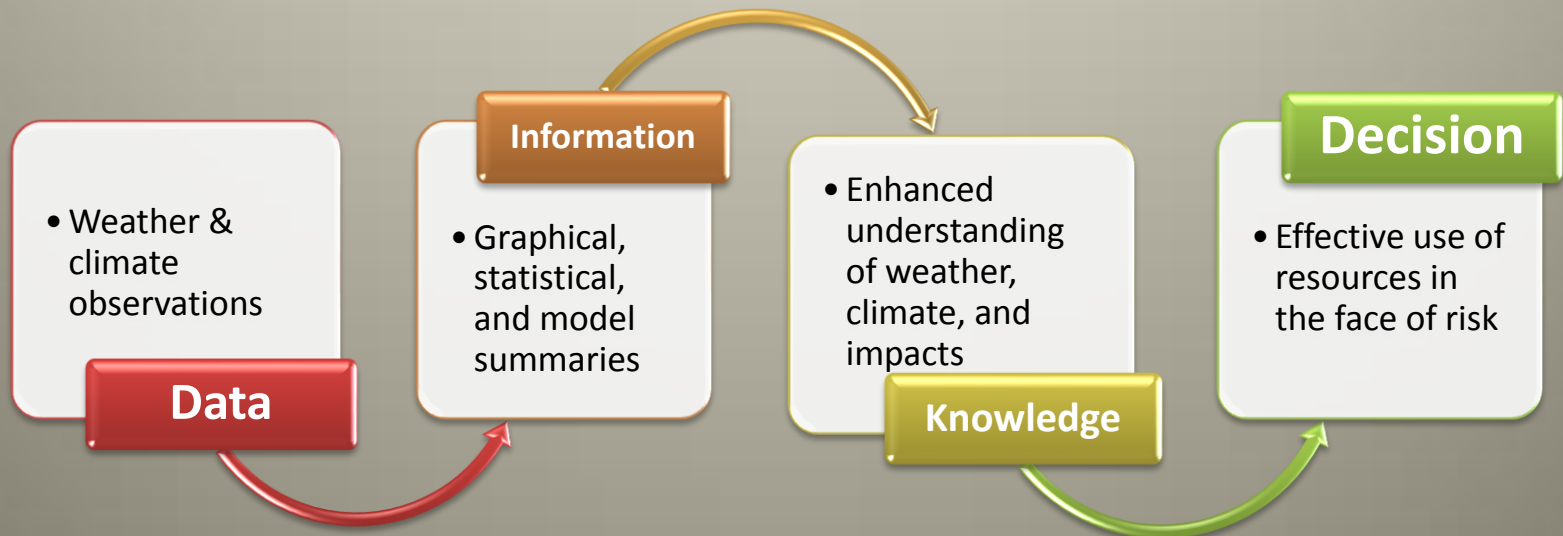


Todd County, October 2010

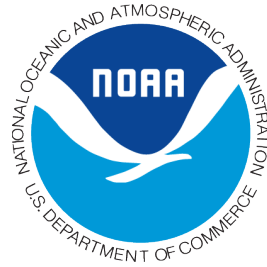


Kentucky Climate Center

- History
 - Established at Western Kentucky University in 1978
 - Recognized by the AASC as the State Climate Office for Kentucky in 2002
 - National Weather Service funding awarded to build the Kentucky Mesonet in 2006



Climate Services Partnerships



NATIONAL CENTERS FOR
ENVIRONMENTAL INFORMATION
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



A Matter of Perspective

Geostationary Earth Observing Platforms



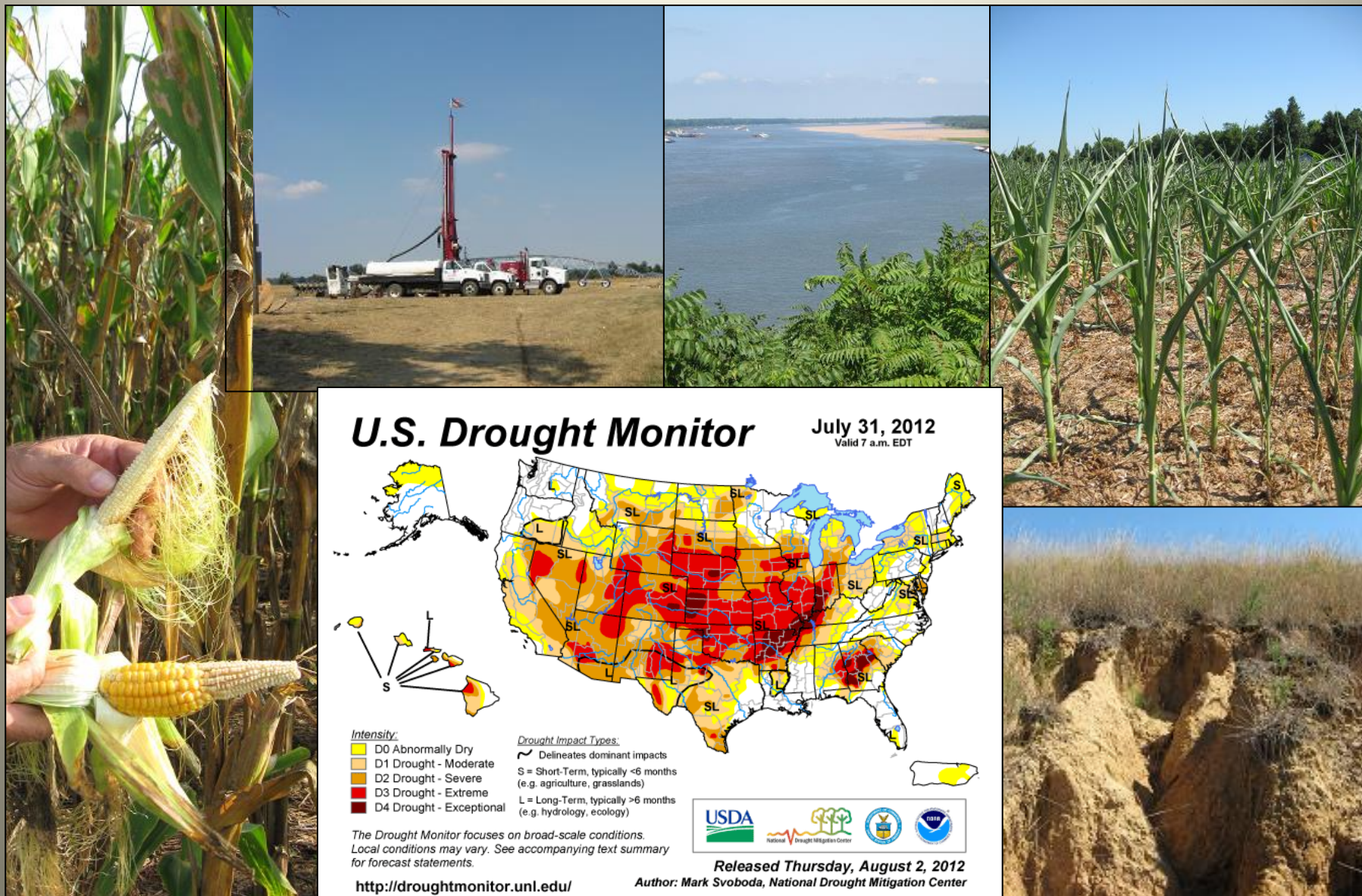
Remote sensing often provides a bird's-eye view, while people see the world from their front porch.

Talking Points

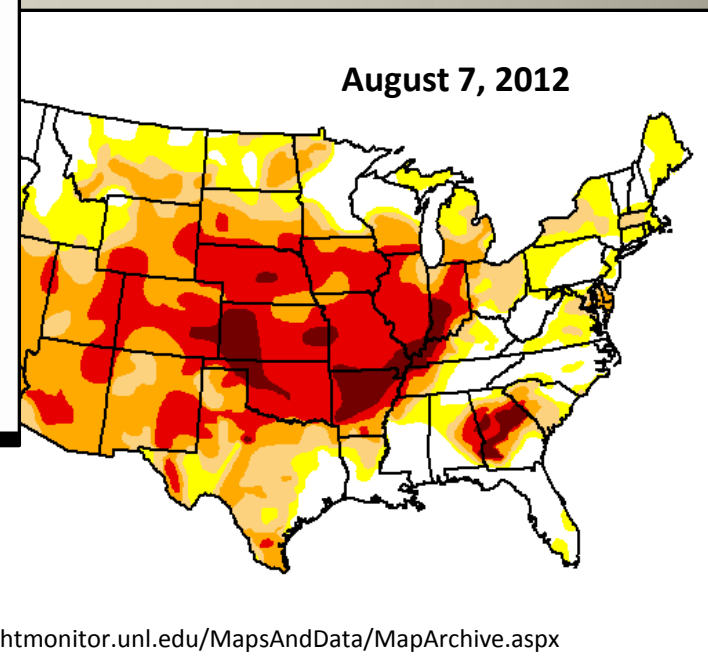
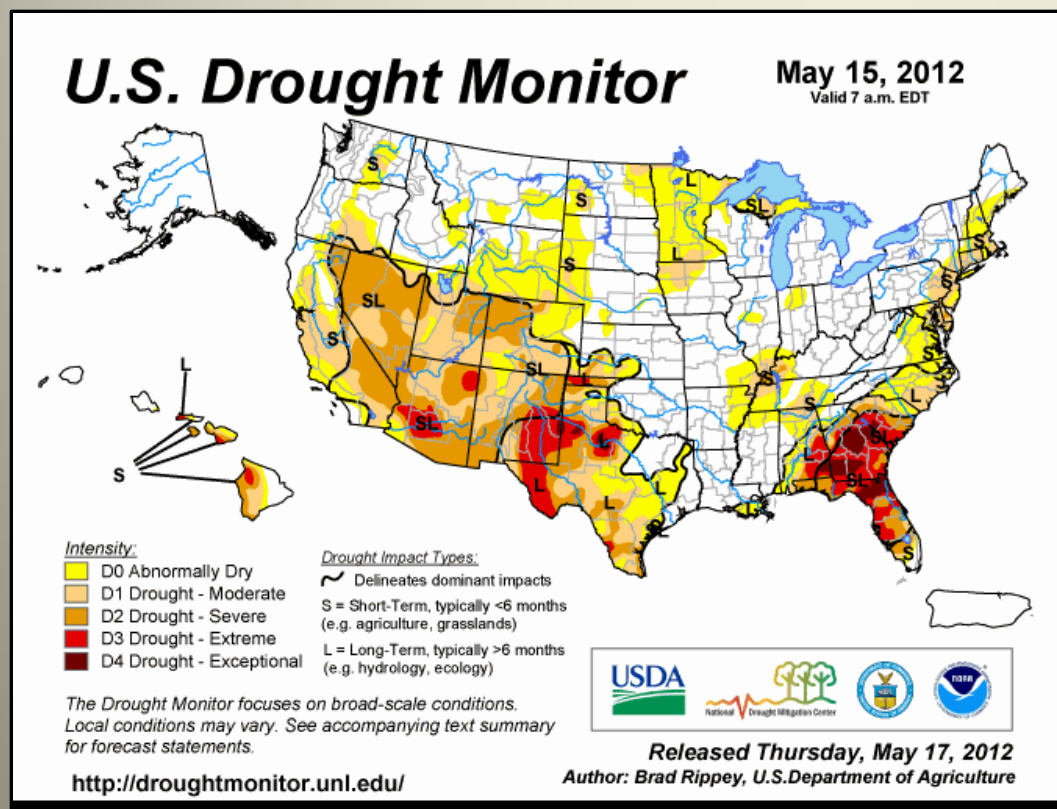


- Perspectives on Drought
- Kentucky Mesonet at WKU
- Strategic Initiatives
- Questions and Discussion

Flash Drought!

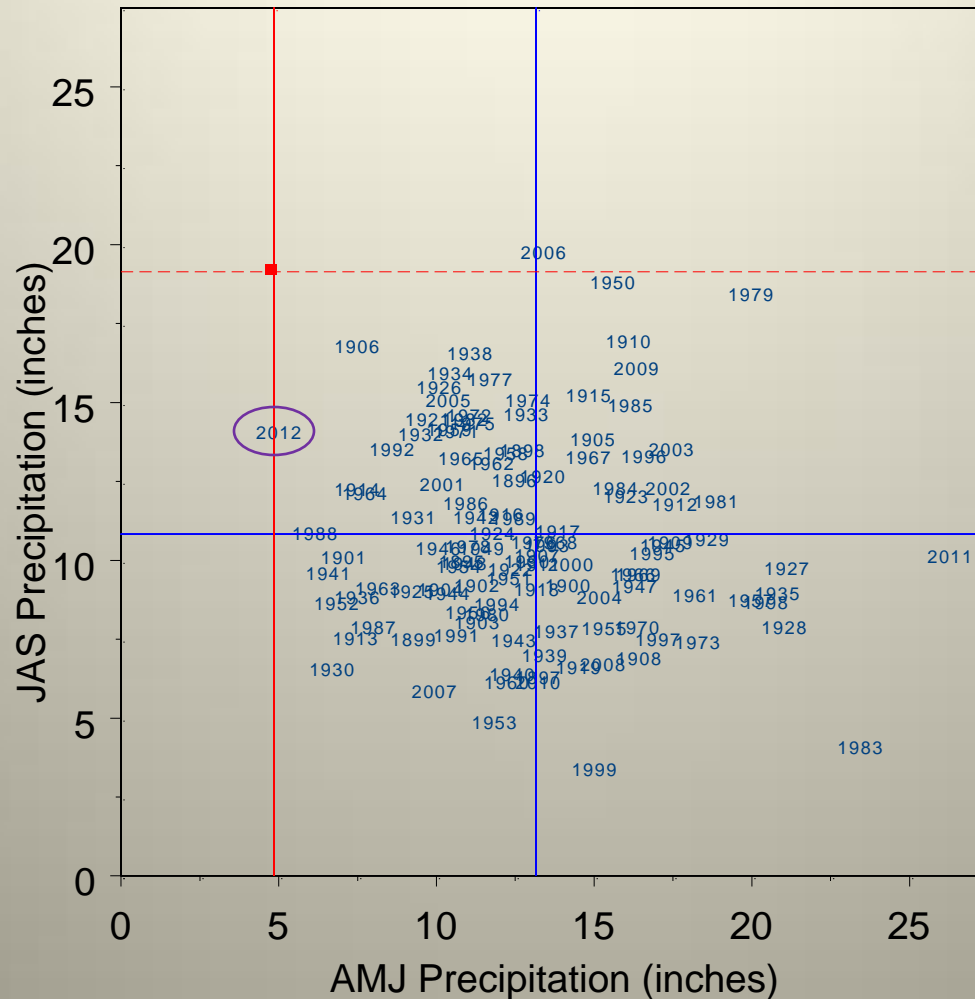


Continental Evolution of 2012 Drought



AMJ and JAS Precipitation, 1895-2011

Western Climate Division, Kentucky



Notes

Vertical blue line represents average¹ AMJ precipitation.

Horizontal blue line represents average¹ JAS precipitation.

Vertical red line represents actual 2012 AMJ precipitation.

Dashed red line represents precipitation for JAS of 2012 required to bring the combined AMJ and JAS total to the average¹.

¹ Average is defined as the arithmetic mean of the climate division values for 1895 through 2011.

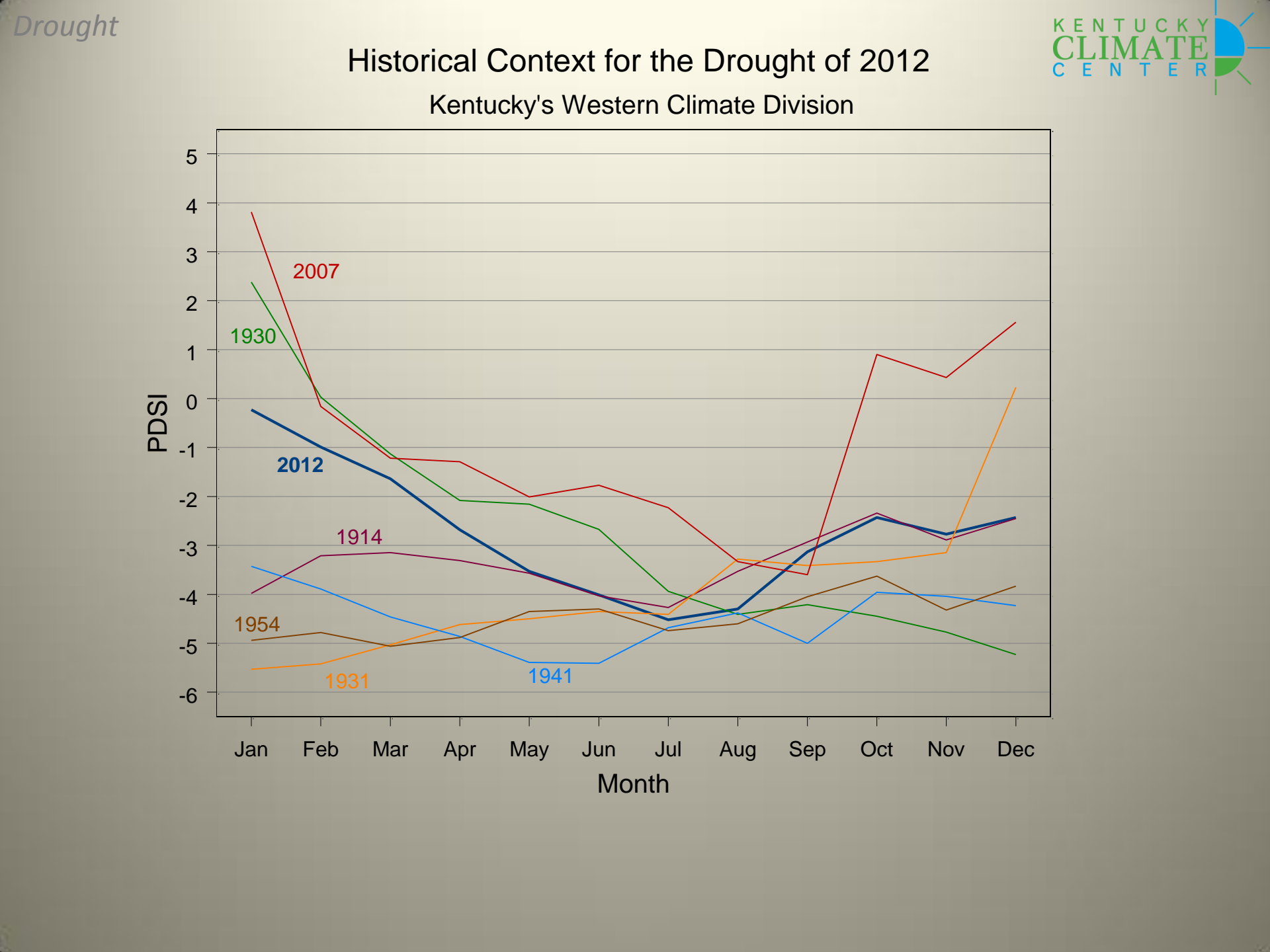
Dimensions of the 2012 Drought



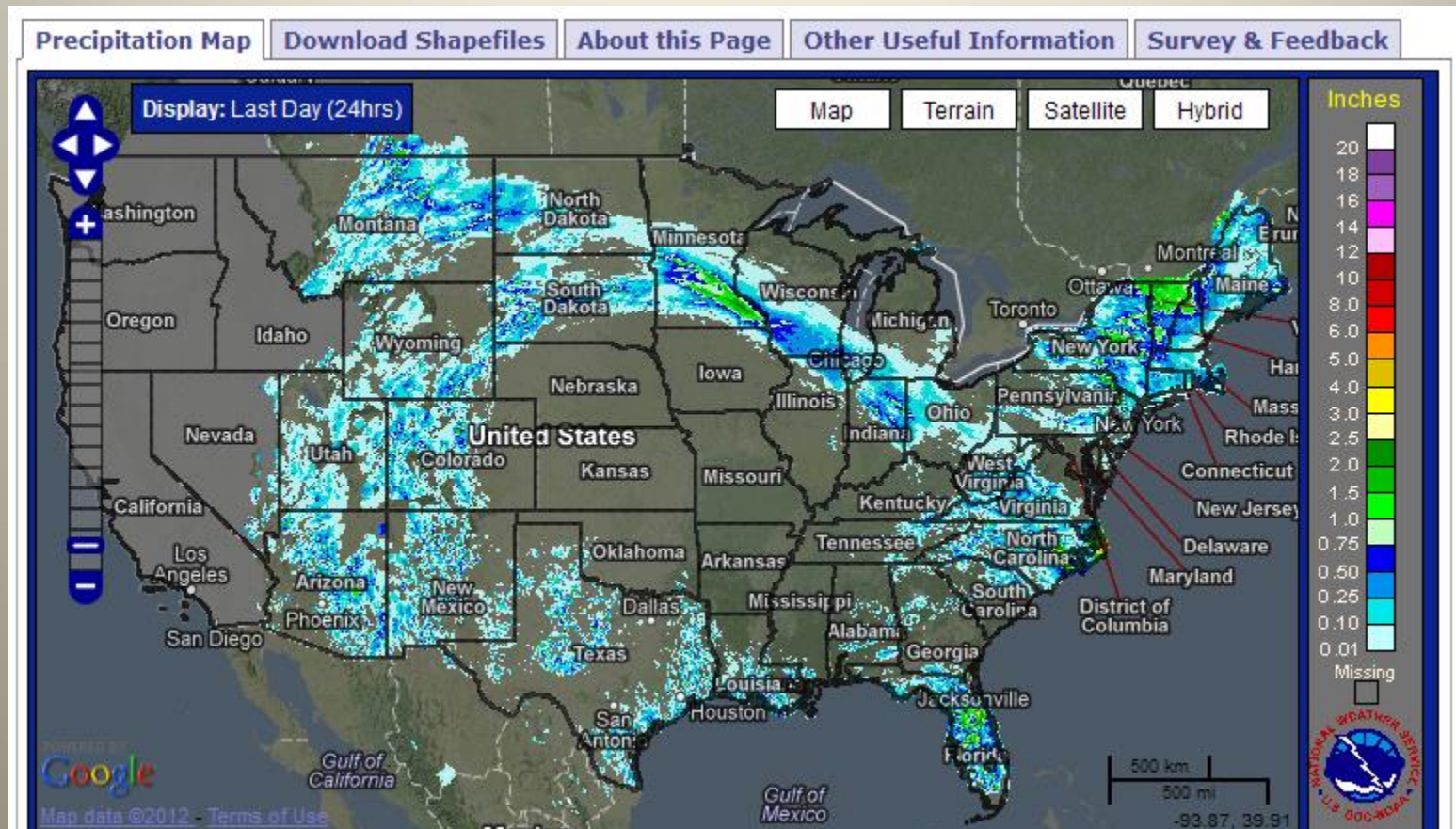
Mayfield, Graves County
July 27, 2012

Graves County

- 3.22" – Precipitation on March 8th
- 4.40" – Precipitation for the entire spring season
- 99.4° - Average high temperature from June 28th through July 8th

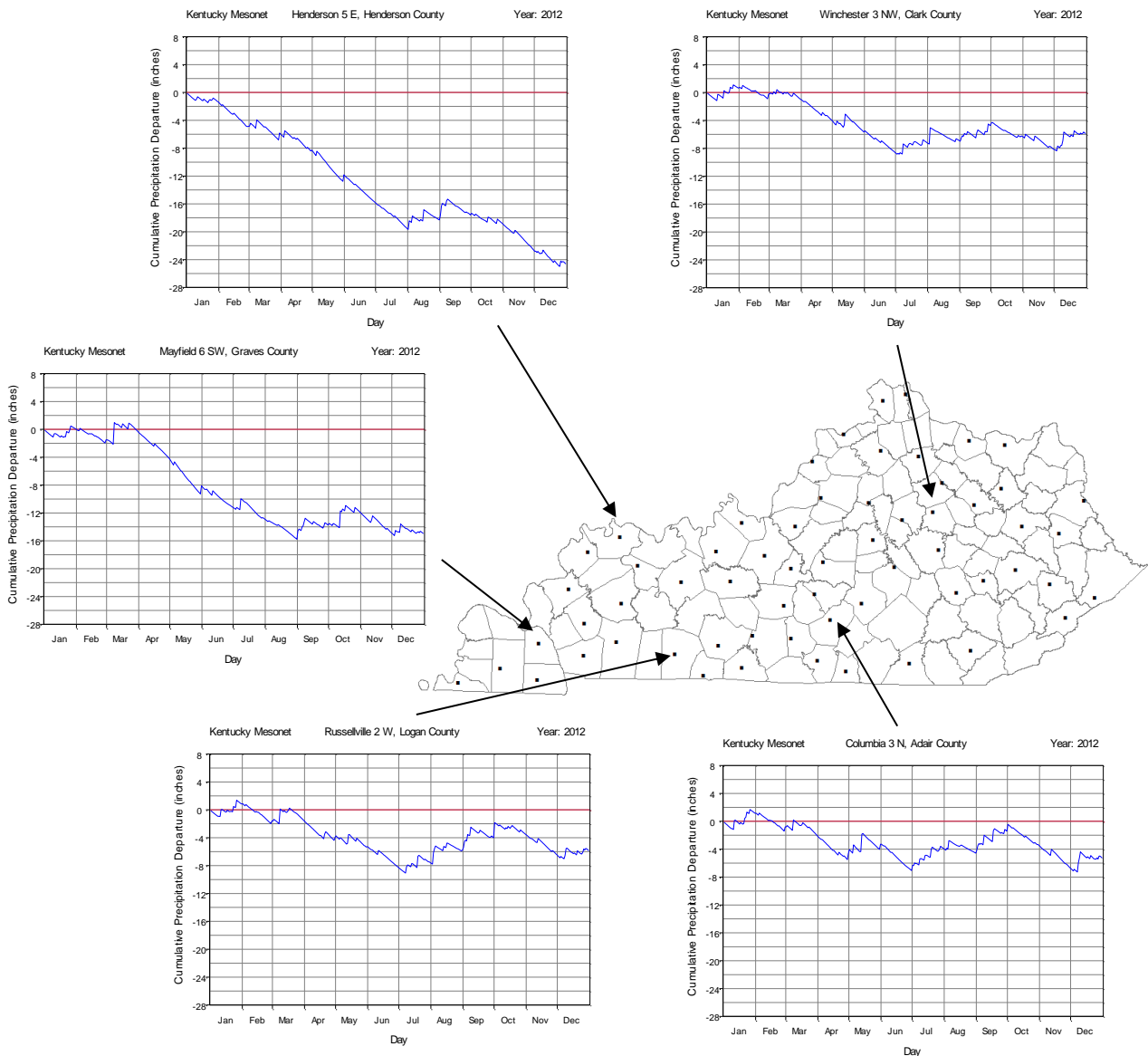


Synoptic Precipitation Pattern in Late July



July 24, 2012

Evolution of the 2012 Drought in Kentucky

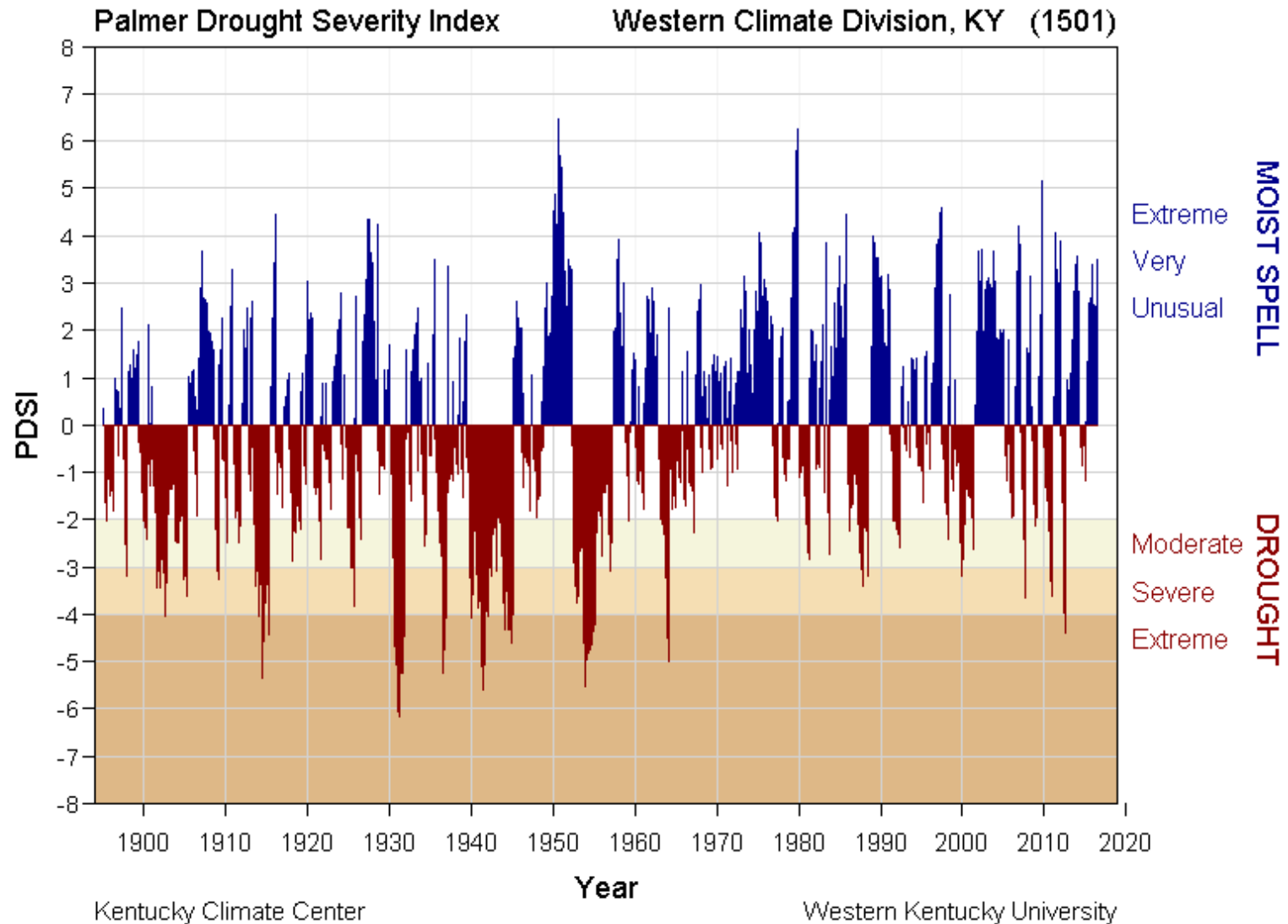


Dimensions of Drought in Space and Time

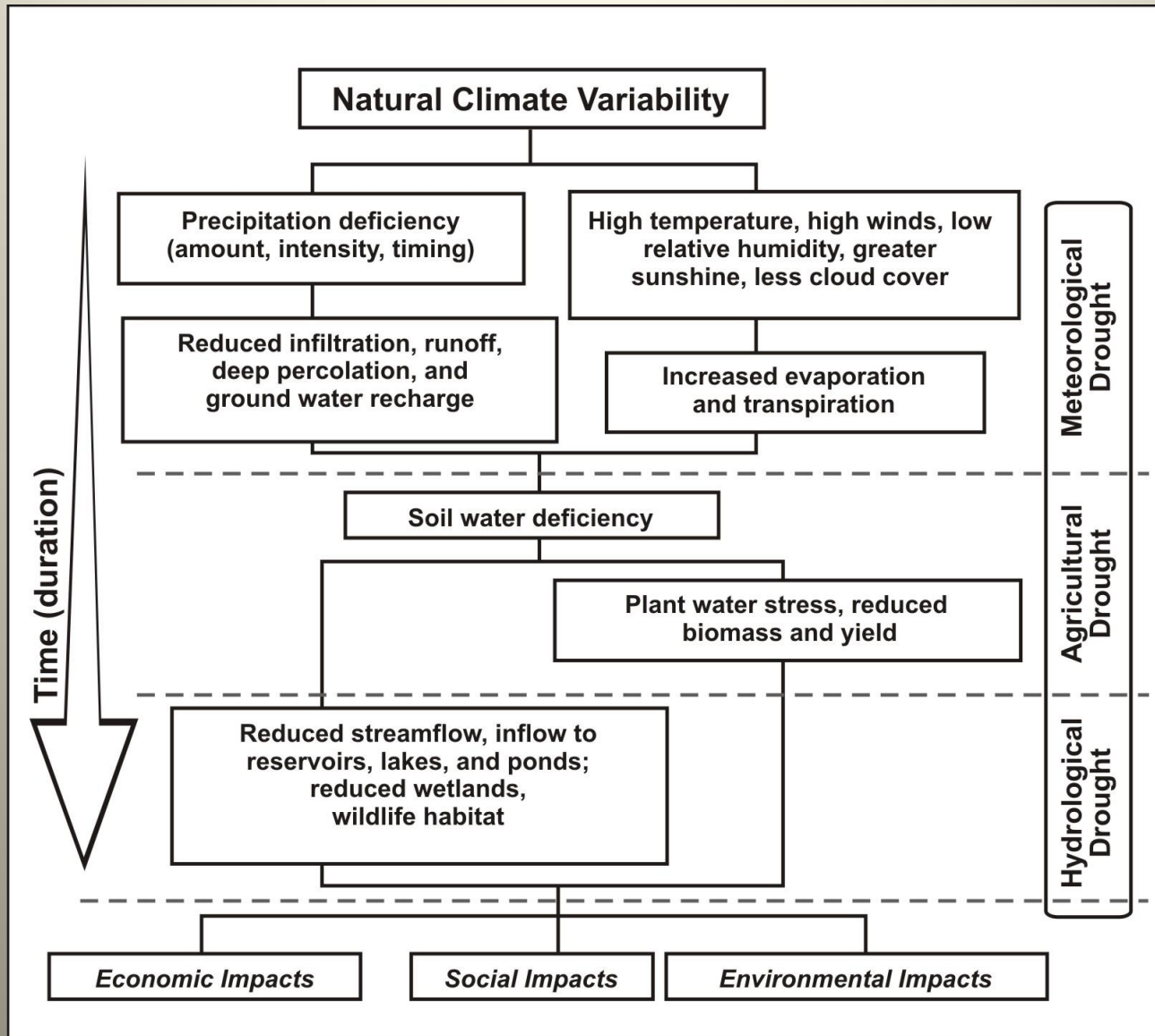


- Onset
- Duration
- Peak Intensity
- Extent

Palmer Drought Severity Index



Types of Drought



Sequence of drought occurrence and impacts for commonly accepted drought types. All droughts originate from a deficiency of precipitation or meteorological drought but other types of drought and impacts cascade from this deficiency. (Source: National Drought Mitigation Center, University of Nebraska-Lincoln, U.S.A.)

<http://drought.unl.edu/DroughtBasics/TypesofDrought.aspx>

Kentucky's Climatological Record

- 1825 – U.S. Army
- 1861 – Smithsonian Institute
- 1874 – U.S. Army Signal Corps
- 1891 – U.S. Department of Agriculture
- 1940 – U.S. Department of Commerce
- 2007 – Kentucky Climate Center

Newport Barracks, July 1825

NWS COOP - Manual



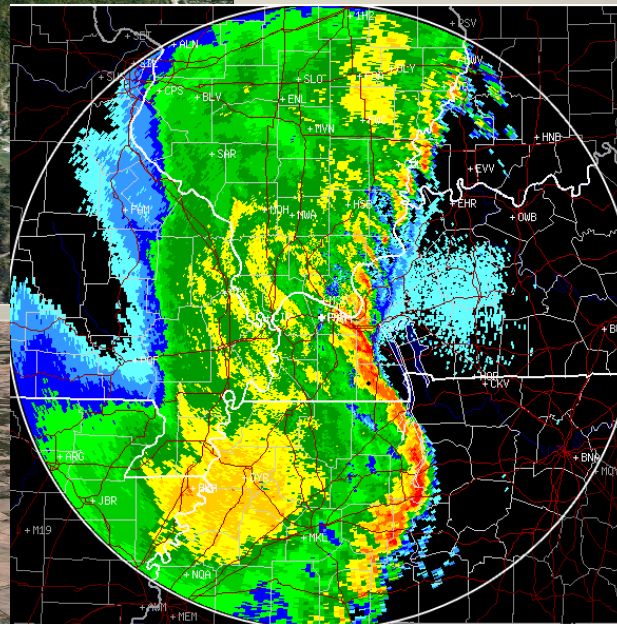
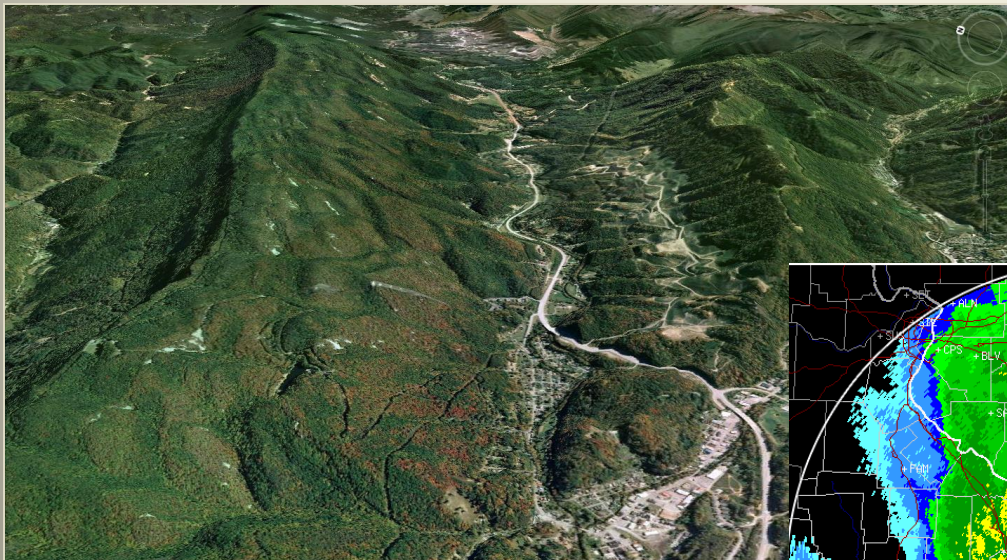
NWS COOP - Automated



Kentucky Mesonet



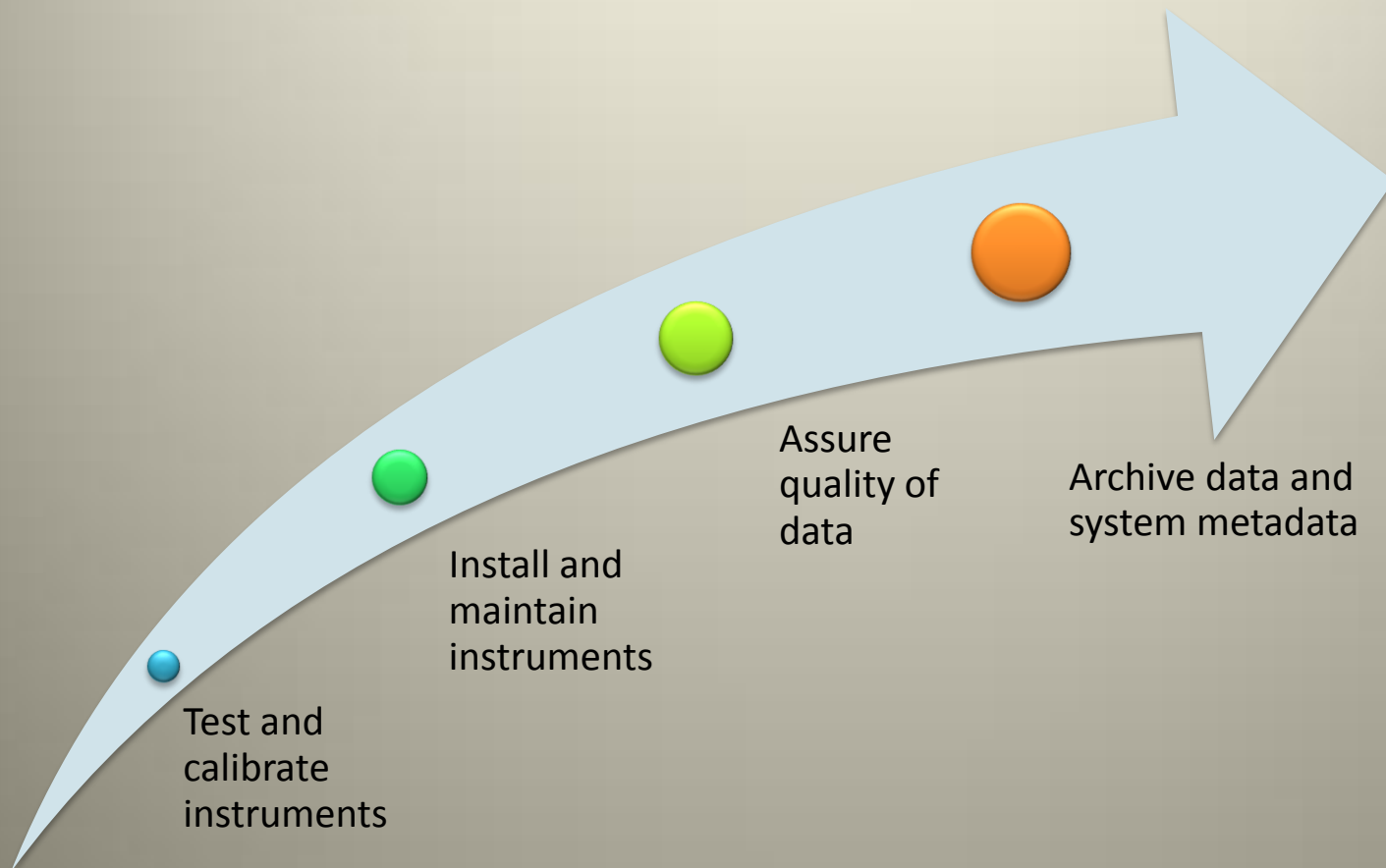
Kentucky's diverse terrain creates distinct local vulnerabilities to weather and climate



Across the Commonwealth



Vertically Integrated System



Site Surveys and Selection

- Candidate sites are surveyed and scored
- Sites are selected with input from NWS and local stakeholders

Survey Scores

Temperature	40
Precipitation	30
Wind	12
Soil	15
Total	97



Station Installation and Maintenance

- Technicians install stations and instrumentation
- Technicians make spring, summer, and winter maintenance passes
- Technicians respond to “trouble tickets” when QA processes indicate problems



Design Criteria Emphasize Quality and Reliability



Temperature



Precipitation

Sensor Package

- Air temperature
- Precipitation
- Solar radiation
- Relative humidity
- Wind speed & direction
- Soil moisture & temperature*

** selected sites*

Package enables
ET calculations



Metadata Database

Equipment History

Calibration History

Effective Time	Performed By	Calibration Location	Equipment Used	Variable	Equation
2008-04-04 16:55:00	Dana Grabowski	KYMN LAB	Fluke 7380 High Pre	TA01	0.9968X+-0.0511
2008-04-04 16:55:00	Dana Grabowski	KYMN LAB	Fluke 7380 High Pre	TA02	0.9968X+-0.0511
					0.9968X+-0.0511

User: aquilligan

KYMN

Manage Sites

Manage Equipment

Manage Sites

Add/Modify Collection Sites

Add Non-Collection Sites

Site Pass

Site Status

User: aquilligan

KYMN

Manage Sites

Manage Equipment

Move Equipment At Sites

All Sites

Russellville 2 W

Manufacturer	Model	Serial No	Vendor	Type
AirLink	Raven Edge E3214	0638149585	Campbell Scientific	Cellular Modem
Vaisala	VRG101	B45102	Vaisala	Weighing Bucket
Campbell Scientific	CR3000-XT-SW-NB-NC	1353	Campbell Scientific	Micrologger
Thermometrics	316-125-1000CR-385-4-TL3	7	Thermometrics	PRT
Kyocera	KC125TM	058101920	Solar Craft	Solar Panel
Kyocera	KC125TM	058101359	Solar Craft	Solar Panel
R M Young Company	05103-5	WM00075165	R.M. Young	Wind Monitor
Vaisala	HMP45C	B3220026	Campbell Scientific	Temp/RH probe

^^ Move Up ^^

vv Move Down vv

Effective Time

December

16

2010

19

59

UTC

Non-Collection Site

Laboratory

Manufacturer	Model	Serial No	Vendor	Type
Thermometrics	316-125-1000CR-385-4-TL3	134	Thermometrics	PRT
R M Young Company	05103-5	WM00075175	R.M. Young	Wind Monitor
Thermometrics	316-125-1000CR-385-4-TL3	138	Thermometrics	PRT
Vaisala	HMP45C	B3230034	Campbell Scientific	Temp/RH probe
Met-One Instruments	076-B	F7077	Met-One Instruments	Aspirated Shield
Thermometrics	316-125-1000CR-385-4-TL3	9	Thermometrics	PRT
Thermometrics	316-125-1000CR-385-4-TL3	8	Thermometrics	PRT
R M Young Company	05103-5	WM00075174	R.M. Young	Wind Monitor
Apogee Instruments Inc.	PYR-P	4048	Apogee	Silicon Pyranometer
Vaisala	HMP45C	B3240065	Campbell Scientific	Temp/RH probe

19:34:00

20:04:00

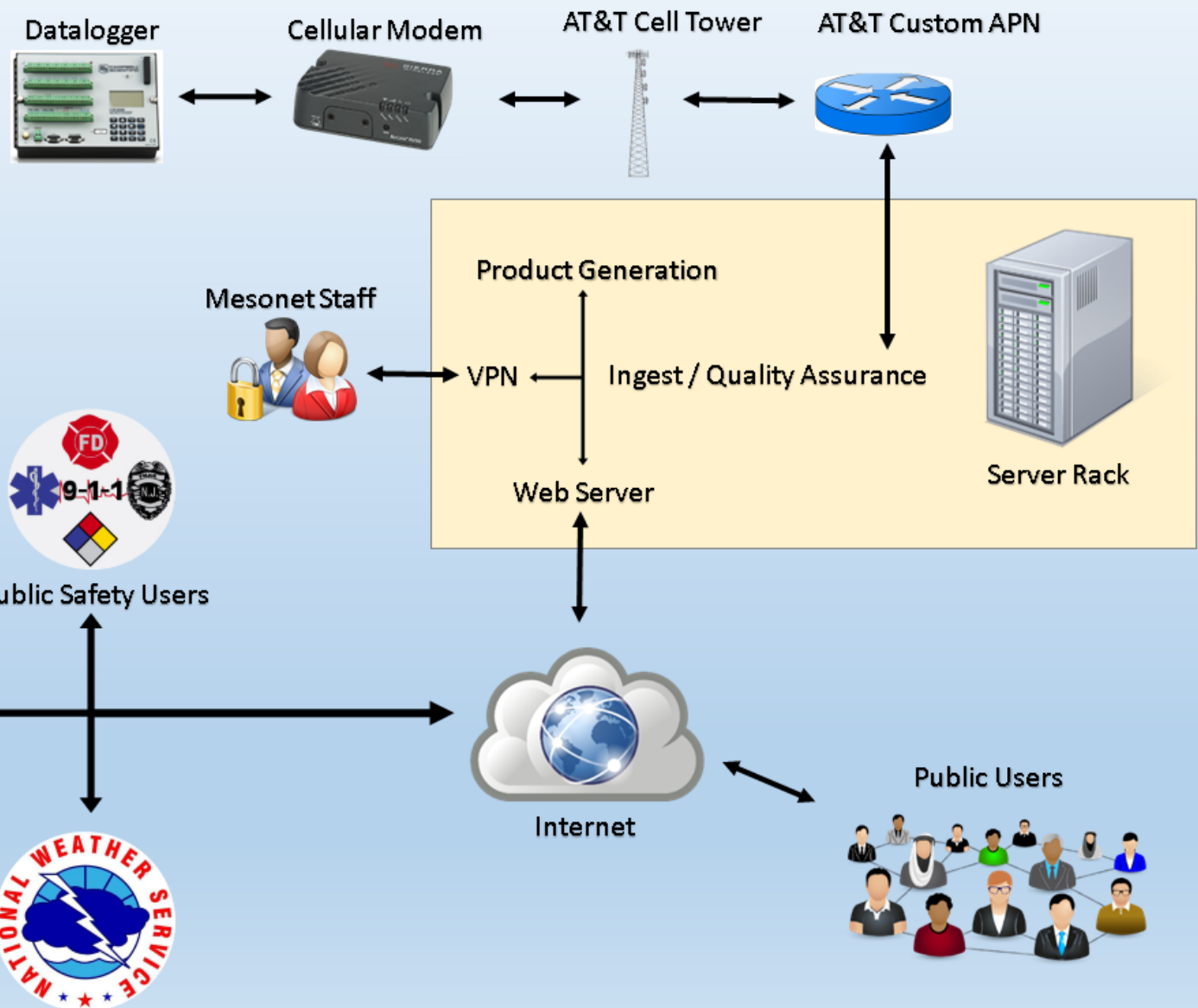
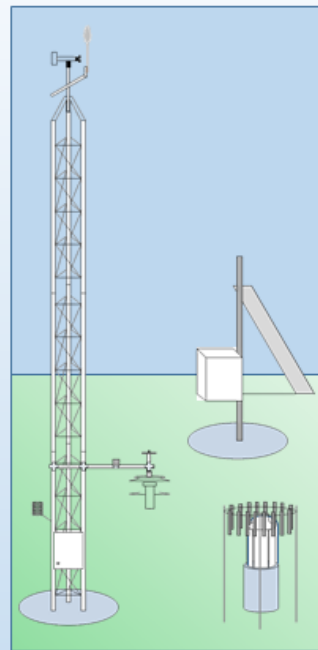
19:34:00

Total time in field: 911+ days

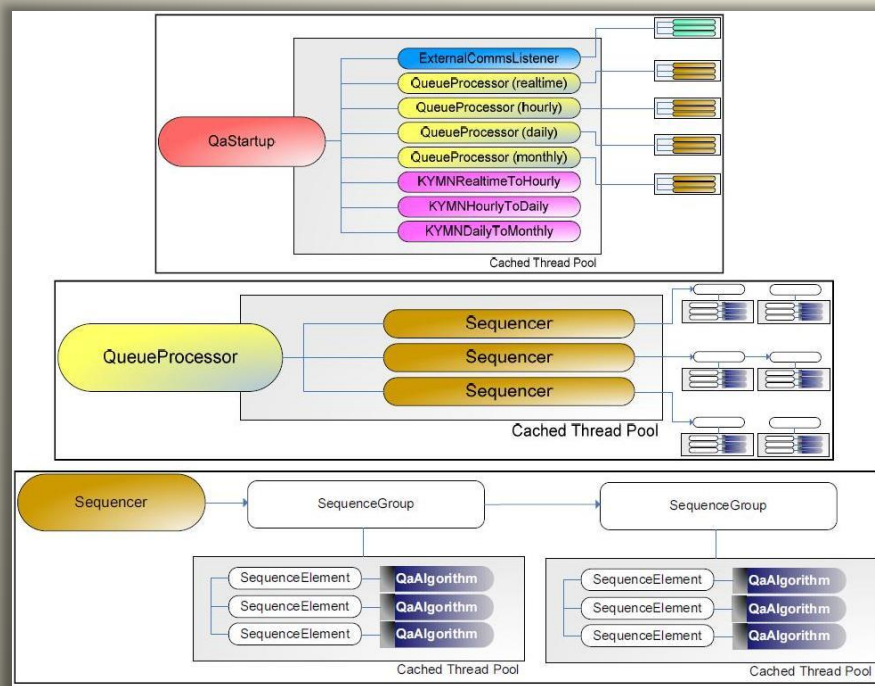
	Location
0	Bowling Green 5 S
0	Laboratory

KENTUCKY MESONET | WKU

MESONET DATA FLOW



Quality Assurance Procedures



- Automated QA runs on five-minute data as they are collected from remote sites
- Manual QA is implemented on a daily basis to provide expert assessment of system performance

Meteorological Database

KYMN,ALBN,TBL_5min,"2010-05-01 11:15:00","2010-05-01 06:15:00 CDT","2010-05-01 05:15:00 CST",69.435,78.7,9.58,171.4,14.76,173.8,9.39,0.0000
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- Observations are taken every 5 minutes
- Each station collects over 105,000 observations each year
- Each station returns over 2,730,000 data values each year

[Home](#)[About](#)[Live Data](#)[Summary Data](#)[Event Tracking](#)[Outreach](#)

+

-

Franklin County, KY

Frankfort 7 S

Dewpoint: 70.9°F

Humidity: 65%

Precipitation: 0.00 in. (SINCE 12AM)

Wind: SE at 3 mph

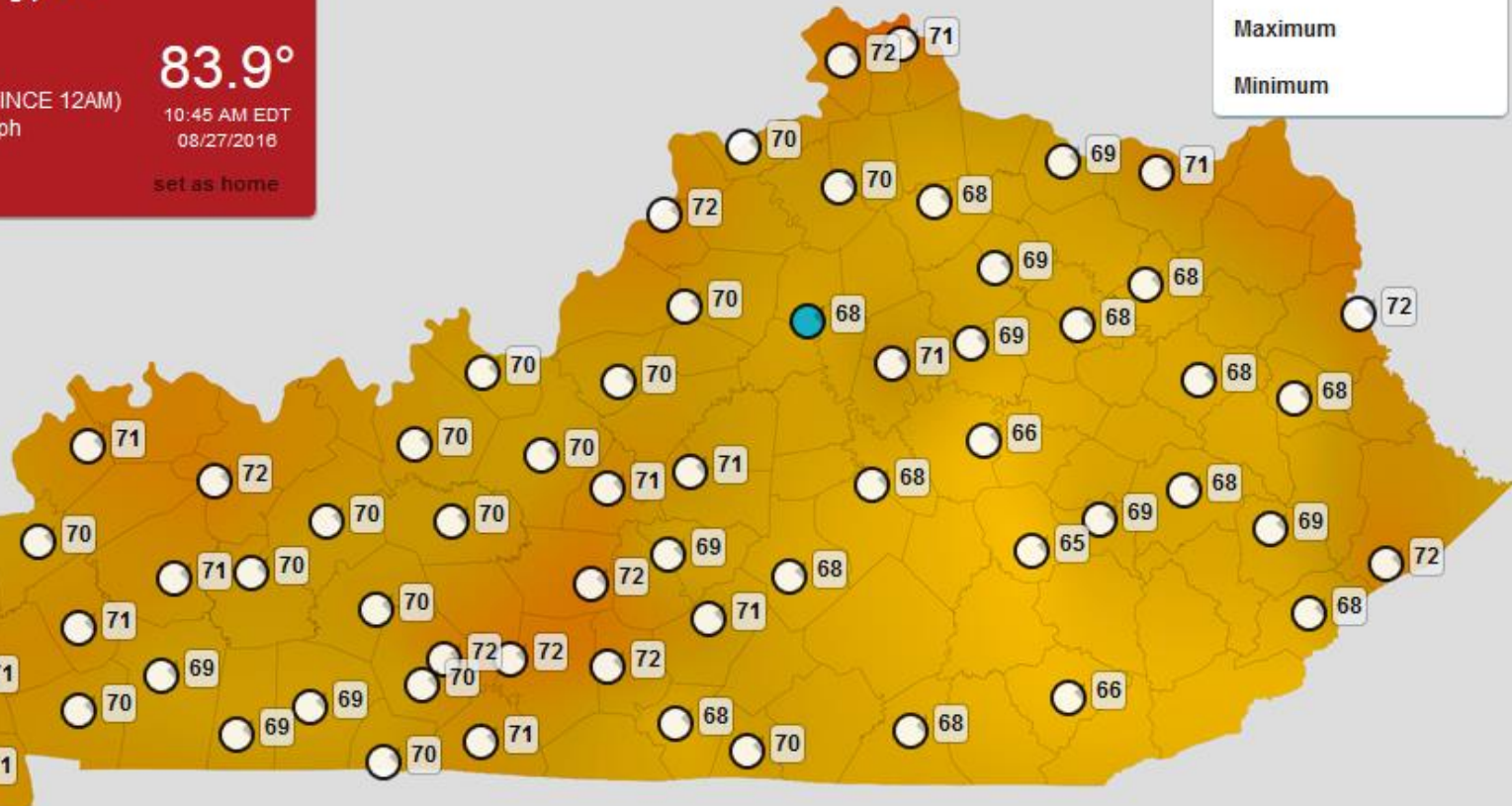
83.9°10:45 AM EDT
08/27/2016[set as home](#)

Current

>

Maximum

Minimum



Air Temperature Minimum Data Points on Air Temperature Minimum Contour Map



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SITE

Franklin County (LSML)

TEMPERATURE GRAPHS

WIND GRAPHS

MOISTURE GRAPHS

PRECIPITATION GRAPHS

✓ PRECIPITATION AND ACCUMULATED
PRECIPITATIONACCUMULATED PRECIPITATION AND
TEMPERATURE

PRECIPITATION AND TEMPERATURE

PRECIPITATION, ACCUMULATED
PRECIPITATION, AND TEMPERATURE

SOLAR RADIATION GRAPHS

TIME INTERVAL

6 HOURS

12 HOURS

24 HOURS

48 HOURS

72 HOURS

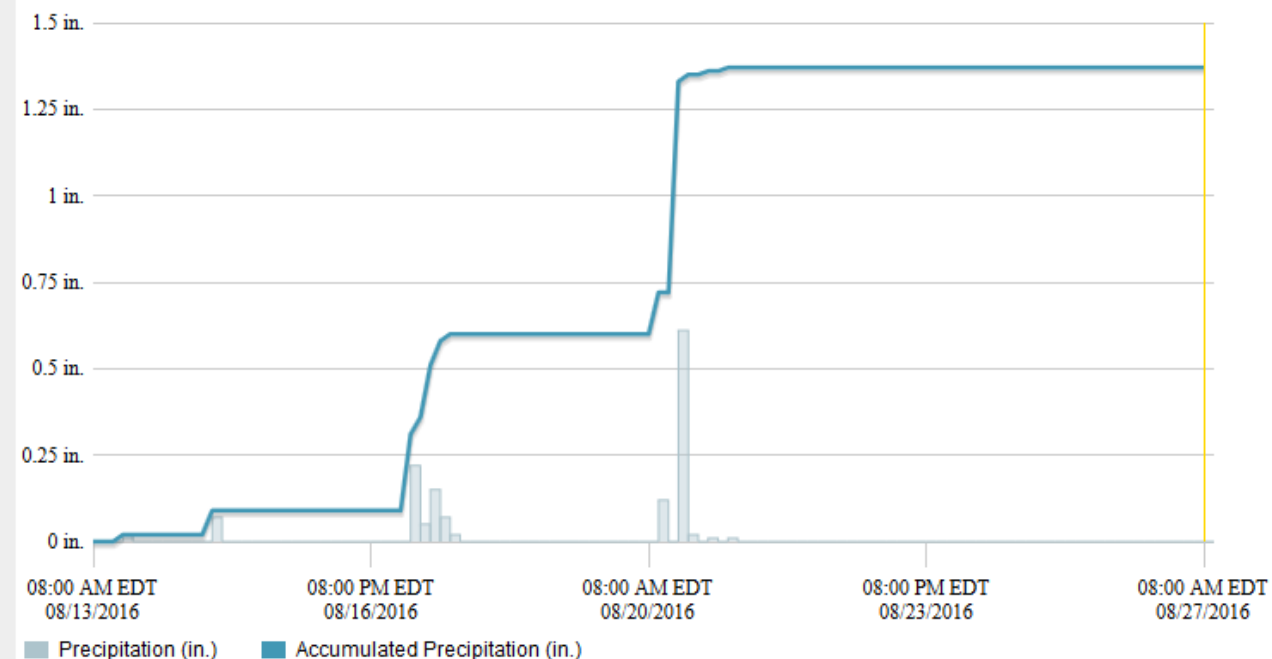
5 DAYS

7 DAYS

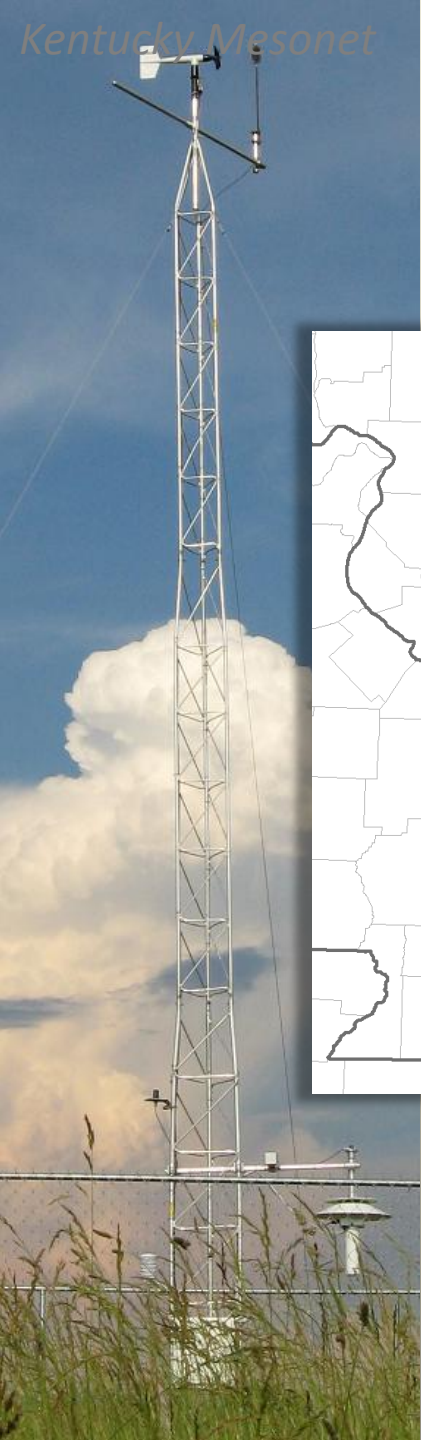
✓ 2 WEEKS

1 MONTH

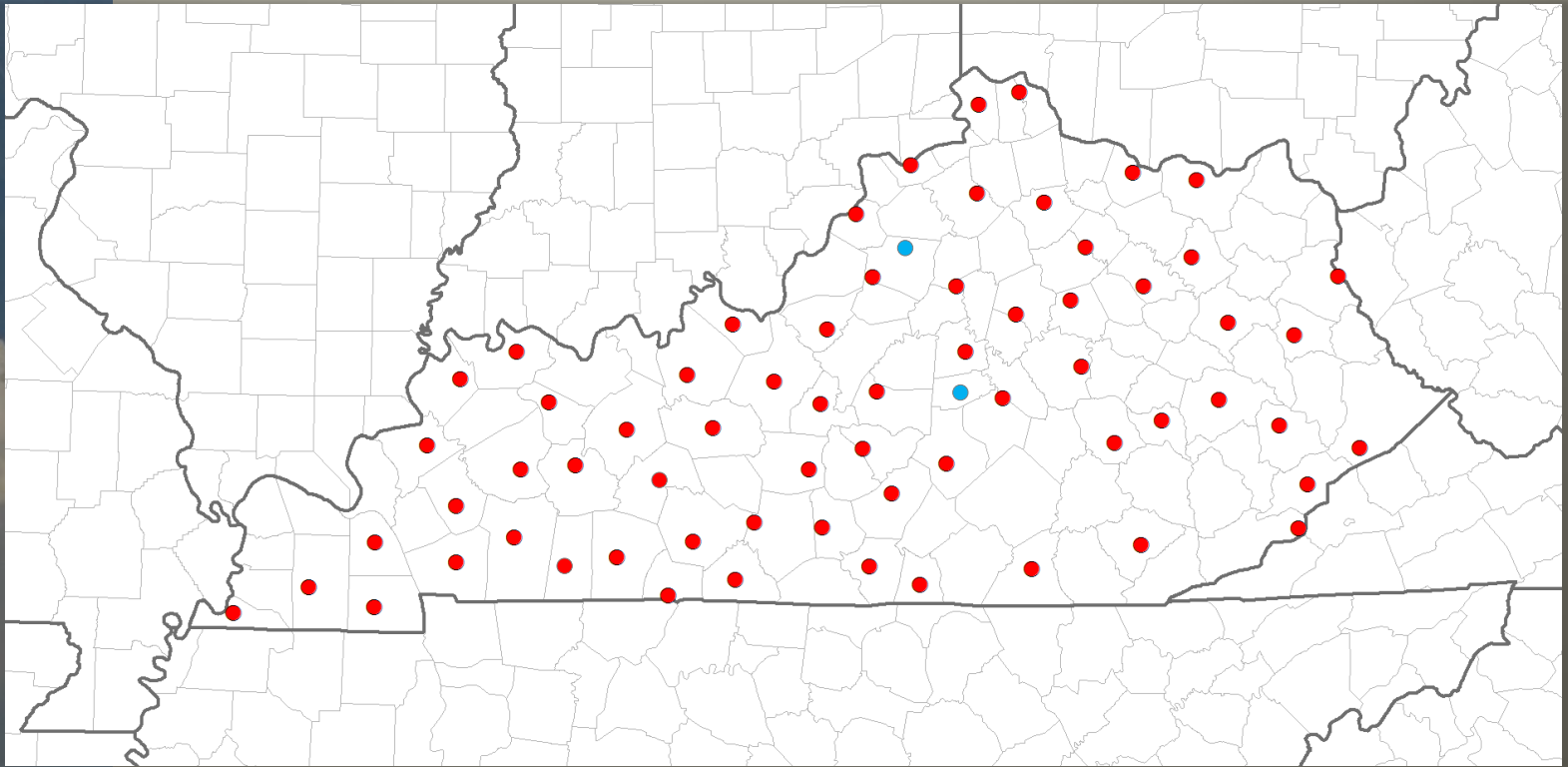
LSML Precipitation and Accumulated Precipitation (14 Day)



Station	Franklin County, KY
Time	08/27/2016, 08:00 AM EDT
Air Temperature	69.6 ° F
Relative Humidity	100 %
Precipitation	0.00 in.
Wind Speed	0 mph
Wind Direction	57 ° (NE)
Wind Speed Max Gust	1 mph
Solar Radiation	97 W/m ²
Dewpoint	69.6 ° F



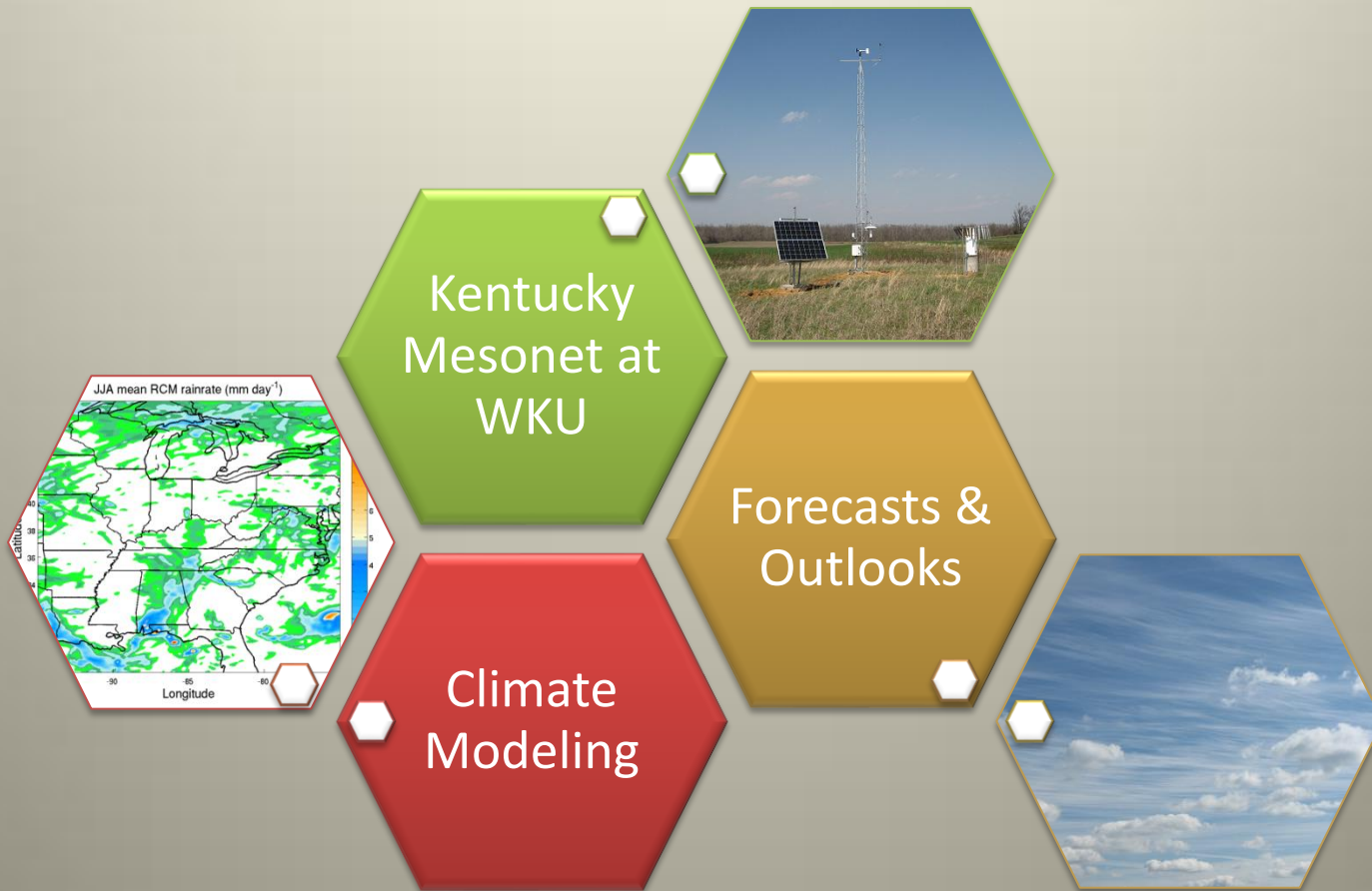
Kentucky Mesonet Coverage Map



● Operational station

● Planned station

Kentucky Climate Center Strategic Initiatives



Kentucky
Mesonet



Strategic Initiatives

Kentucky Mesonet at WKU

- Add 10-12 stations to fill coverage gaps and custom stations to meet local demand
- Enhanced instrumentation package
 - Soil probes (where not currently deployed)
 - Multi-level temperature and wind
 - Add barometric pressure sensors
- Add 3 atmospheric flux monitoring stations

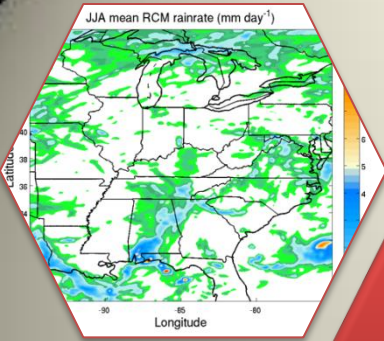
Targeted completion by FY19

Forecasts & Outlooks



Strategic Initiatives Forecasting & Outlooks

- Develop an operational unit to provide customized weather forecasts and climate outlooks
 - Hire staff meteorologist and student interns
 - Utilize existing NWS forecast model output and develop option to generate forecasts incorporating mesonet data
 - Provide client-focused forecast and outlook products. For agriculture, these would include
 - forecasts relating to stress on crops and livestock
 - outlooks for growing degree days
 - forecasts for irrigation scheduling



Climate Modeling

Strategic Initiatives Climate Modeling

- Conduct meso-scale simulations to model impacts of land use/land cover change on atmospheric conditions
- Provide high-resolution, downscaled climate model projections for Kentucky based on model runs reported in the most recent National Climate Assessment
 - Models can be run for various time horizons



Questions?